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VIEWS OF JAPANESE MISSION  
ON  
WATER RESOURCES DEVELOPMENT IN TANZANIA

August 1968

OVERSEAS TECHNICAL COOPERATION AGENCY

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## Preface

Placing higher priority on the water resources development in Second Five-year Plan, The United Republic of Tanzania, established The National Water Resources Council in February 1968, which acts as a body corporate with the principal responsibilities of preparing development plans for the river basins of Tanganyika and project feasibility reports and also advising the Government generally on the utilization and development of Water resources.

The Tanzanian Government expressed her willingness to the Government of Japan to obtain the services of an expert who would perform the duties of Planning Director of the Council.

Prior to sending the experts headed by Mr.K.Nakazawa, chief of Ede-river Construction Office, Ministry of Construction, from March 31, 1968 to Apr. 30, 1968, for the purpose of studying the requirements for the Council and reviewing the available data of Water resources in the country and investigating Kagera River Kakono High Dam Construction Plan.

Published herewith are the reports and recommendations prepared by the experts to the Government of the United Republic of Tanzania.

It is hoped that this report will be made full use of and contribute to the future development of water resources of the country.

Shinichi Shibusawa  
Director General  
Overseas Technical Cooperation Agency

MAY 15, 1968

Mr. C.D.MSUYA  
Principal Secretary  
Ministry of Economic Affairs &  
Development Planning

Dear Sir,

The Japanese technical mission has the great pleasure to submit herewith the views and opinions of the team on water resources development in the Government of the United of Tanzania, which, the team hopes, would be of material for implementation of various projects in Tanzania in very near future.

Kazuto Nakazawa

Katsumi Naito

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## § 1. General

### 1.1. Summary

1. By the official request of the Government of United Republic of Tanzania, the Government of Japan dispatched a team, consisting of five experts to Tanzania at the beginning of April 1968, to review the planning activities of the National Water Resources Council with a view to selecting the most eligible person for a planning director of the Council. It was also one of the tasks for the team to review the data in respect of the Kagera (Kakono) surveys and investigations.
2. Wonderful arrangement for the team to see most of the very important personnel concerned with water resources development planning had been made while the team stayed in Tanzania. Time did not permit the team to fully examine all of various informations and data, particularly reports on water resources development projects prepared by various consulting firms, but we are grateful to the courtesy of the Ministry of Economic Affairs and Development Planning which provided us with the above said reports.
3. The team was also able to visit the Kagera River Basin by utilizing a chartered Government plane provided by the Ministry for a period of between 16th and 20th of April.
4. Although the time for the team to be able to afford was limited, the team believes the assignment was accomplished to such extent as the team can give several comments and recommendations regarding water resources development in the Kagera River Basin as well as the organization of the Water Resources Council.
5. This report summarizes views and opinion of the team on plan- nings of water resources development in Tanzania, particularly on the Kagera River Basin Development Project including comparative study of the Kakono high dam project and alternative develop- ment projects.

6. One of the important in this report is a suggestion on organization of the Water Resources Council, which is to function as a super-structure of water resources development organizations in the Government of Tanzania. Suggestion by the team is particularly connected to the secretariat machinery of the Council since how to organize and how to operate the secretariat of the Council is considered to be vital for the Council to carry out its objective.
7. Although these subjects are beyond our assignments, it might as well be added before conclusion that the team felt urgent necessity of training of staff and improvement of technical requirement for acceleration of water resources development of the Country.

## 1.2. Recommendations

### 1.2.1. Establishment of Agriculture under irrigation

8. In due consideration of the fact that construction of irrigation facilities such as dams, reservoirs, waterways etc. requires a large amount of investment, the Government of the United Republic of Tanzania is recommended to establish systems of agricultural technique for the regions where to be irrigated in the country, including farming and cultivation technique and mobilization of farming machinery and so on, and to carry out economic policies, including aid plans for construction of such facilities on comprehensive and consistent scale.
9. The team, judging from meteorological conditions of this country, recommends that the Government of the United Republic of Tanzania should attach more importance to paddy rice plants and should make her utmost efforts to promote researches and experiments for selection of best fit species of paddy rice plants for this country.



10. Considering the sharp increase in rice demand of the world expected in the future, the Government of Tanzania is recommended that it should promote to increase her production of rice as one of its important economic policies in order to not only dispense with imported rice but export the possible excess of rice production to foreign countries so that the Government of Tanzania could improve its foreign exchange position.
11. Since the land tenure system which has been applied in the United Republic of Tanzania has various advantageous points from the viewpoint of international trades, the Government of Tanzania is suggested to make its effort to maintain this system, and to adopt special devices to push forward the development of undeveloped inlands of the country.
12. The team recommends that price policy in which an ex-farmhouse price in the under developed inlands is equalized to the one in the coastal regions be under taken for one of price policies in agricultural aspect. For this purpose it is advisable to adopt special tariff system for transportation of agricultural products in which the longer the transportation distance the lower the rate of tariff.
13. Various way of subsideization to the farmers in the underdeveloped regions for financial aid to the construction of such agricultural facilities as dams should be considered so that farmers could their shares to construction cost as less as possible.

#### 1.2.2. Electric Power Generation

14. Considering the fact that construction of hydro power stations requires considerable longed of period of preparation and of construction works, construction of hydro-electric power station only can hardly meet increasing domestic electric demands which is expected to be double in 4 - 5 years. If thermal power generation takes base load out of the daily

Load-Curve, the unit cost of electric power generation will be less expensive.

The team felt necessities of construction of thermal power stations with large capacity in order to economically meet increasing electric demands and further connection of the stations with power-transmission lines in coast districts now under construction.

15. The United Republic of Tanzania does not produce petroleum and then construction of hydro power stations has to be accelerated. For preparation of realization, surveys for site selection of hydro power station have to be conducted together with collective and compilation of hydrologic data and materials.

16. There are many international rivers in the limited Republic of Tanzania.

In cooperation with various foreign countries concerned, market surveys on electric demands and a development survey are suggested to be carried out on joint bases.

Establishment of a joint committee should be considered as well.

### 1.2.3. Flood Control and Hydrology

17. Metrological condition in the United Republic of Tanzania varies by regions. In preparation of flood control planning, due consideration should be given to meterological conditions peculiar to rivers concerned. In this case, it is recommended that advises be given by meterological experts.

18. It should be understood that collection and compilation of data and records on precipitation and run-off is most fundamental in preparation of water resouces development projects, especially in case of flood control planning. Efforts for collection and completion of such materials should be made through systemization of material exchange with the neighboring countries in case there is anything to do with these countries.

19. River channel improvement is one of main measure for flood control in addition to construction of dams. And, river channel improvement for flood control should be taken into consideration from the economic viewpoint in case of countries like Tanzania where construction of a dam costs expensively mainly because of topographical conditions. Under such circumstances, it is recommended that plannings and surveys for river channel improvement be conducted by hydraulic engineers and water engineers on a country wide scale.

#### 1.2.4. Agriculture of Kagera River Basin

20. Production of cash crops in the districts at the northwestern part of this country can not be expected profitable from the viewpoint of transportation costs. The loss due to the above disadvantage, however, could be covered by the possible price policy.

21. The constituent crops in Tanzania will be paddy rice. The above expectation is made because abundant stream flow of the Kagera River even in the dry seasons enables rice plantation throughout dry, hot season, and because meteorological conditions in the highlands in this country are suitable for hard labors by farmers on paddy rice plantation.

22. The team recommends that a pilot farm be established by the budget itemized in research and survey for dam construction and demonstration of paddy rice plantation in the farm should be conducted by the Japan Peace Corps Volunteers. The team, in addition to the above, recommends that experimental farms for paddy rice plants be established as early as possible in the country of Tanzania. Leasing land within domain of sugar cane estates for the above experimental farms may be suggested.

23. Technical cooperation by the Japanese experts who have experienced in educational and guiding services for double-cropping in the Federation of Malasia must be effectively available. Dispatching such engineering experts, of course, is subject to approval of the Government of Japan.

1.2.5. Development of Kagera River Basin

24. The Kagera River is one of the international river in the United Republic of Tanzania and it is needless to say that consultations with various foreign countries concerned are required for the development of the River.

The team understand that the project for development of the River proposed by the team has extremely close connection with Uganda which may demand considerable domestic electric power.

Therefore, the team recommends that market survey on electric-power demands be commenced through holding of conferences of joint survey committee consisting of representatives of countries concerned.

Electric power demands in Bukoku district are not expected to be sharply increased for the moment.

The joint survey committee introduced above will develop in the future to the Joint Committee for Comprehensive Development of Kagera River Basin.

25. Records of hydrological data such as precipitations, water level and discharge which are fundamental for preparation of the development of the Kagera River Project, should be collected by the Government of Tanzania in cooperation with foreign countries concerned by means of the unified form and unified accuracy.

26. The projected water-level of the Lake of Victoria exerts an important influence upon river development planning for the lower basins of the Kagera River and development of the areas behind.

In this connection, it is necessary to collect and compile records and data concerning lake-level, total amount of inflow

and outflow in and from the Lake of Victoria, which will play an important role in planning of river channel improvement scheme when performed later.

In this sense, "Hydro-Meteorological Survey of Lakes Victoria, Kioga and Albert" conducted jointly by five countries concerned under the auspices of World Meteorological Organization (W.M.O.) is highly appreciated.

27. For development of coastal region of the Lake observations of run-off and water level of the Ngoni River and the Muisa River, tributaries of the Kagera River will effectively contribute to preparation of river channel improvement plan, water utilization plan as well as drainage plan of the Basin.
28. Survey and investigation on the range and depth of swamps is very important in analyzing functions of swamps in flood control. The survey above mentioned may be useful to know how the run-off of the Kagera River is changed after swamp area is developed.
29. It is essential to classify pedological characteristics and to decide priority of land improvement through extensive pedological survey.  
The above arrangements are the most important matters for establishment of land utilization plan in connection with possibility of water utilization, topography, precipitation and temperature.
30. Since temperature and evaporation are greatly related to amount of water required for irrigation, surveys and investigations on them should be conducted in order to decide quantity of irrigation water for the area under question.  
For this purpose establishment of experiment farms is useful to obtain informations of the necessary amount of water for irrigation.  
In consideration of double cropping of paddy, detailed investigation and research on amount of water necessary for irrigation have to be conducted simply because extent of availability of water in the river is vital element for preparation of effective water resources development project.

31. The Kagera River development project the team proposes can be divided into two stages.  
Before realization of second stage works, it is essential to consider harmonization of design of second stage structure with the first stage for better exploitation. Result of first stage construction has to be taken into account for the second stage planning.
32. With respect to irrigation of the left bank area of the Kagera River as well as the Mingiro Forests area located on the left bank of the River for the second stage, a project with pumping station is considered to be advisable. Examination on this matter has to be made in relation with planning of electric power generation (for supply and demand aspect).
33. Improvement of swamps in lower reaches of the river necessitates drainage of the regions together with the river channel improvement. It follows that implementation of river channel improvement scheme has to be given priority for this purpose.
34. One of possible development plannings of the Kagera River, the Kakono high dam scheme which is desired by the local inhabitants is the first plan, the plan which the team proposes the second and the plans which include development of the Rusumo Fall and the Murongo Gorge are other alternatives. The former two plans may be worthwhile to study without considering any to the latter.  
For the meantime comparative study on the former plannings of the above is recommended in order to make a decision for selection of the best planning out of the two, which do not include the border problem. Basis of comparison is political viewpoint and funds which the Government can afford to allot for development of the Kagera River Basin along its national development schedule.
35. The team believes that ratio of investment against amount of gross product of the proposed planning by the team is reasonable enough to make the planning economically sound.

### 1.3. Assignment

At the end of March 1968, under the Technical Cooperation Programine of the Governmēt of Japan for Middle East and Africa, the Overseas Technical Cooperation Agency of Japan organized a group of experts consisting of three engineers, are agricultural economist and are economist to study the planned activity of the National Water Resources Countil of the United Republic of Tanzania with a view to selecting the most eligible person for the post of a planning director of the Council. The team was also assigned to review the data and information in connection with the Kagera River Basin Development.

Organization of the team was made based upon instruction by the Ministry of Foreign Affairs of the Japanese Government since the Umbassador of Japan in Tanzania, had received a letter dated March 7th, 1968, from the Principal Secretary of the Ministry of Economic Affairs and Development Planning, the United Republic of Tanzania, in this respect.

Terms of reference in the letter reads as follows;

To review the planned activities of the National Water Resources Council with a view to selecting the best person for the post of a Planning Director.

To review the date in respect of the Kagera (Kakono) surveys and investigations.

Under the above said terms of reference, the team was to study how the idea of the Water Resources Council came up, to give comments on the idea and to suggest desirable organization of secretariat machinery of the Council.

Another assignment of the team was to review the data and informations in respect of surveys and investigations of the Kagera River Project and to make a recomaissance examination of the Kagera River Basin.

## § 2. Review of the Plannings of Water Resources Development in Tanzania

### 2.1. Establishment of Agricultural technique under Irrigation

#### a) Selection of best species of Agricultural Products

1. The water resources developments for the Rufiji River, the Pangani River and the Nile River basins etc. were prepared by various consulting firms in the world. Attention should be drawn that these development plannings have a common feature in designating paddy rice and sugar cane as important main crops.

It is quite natural to give the above conclusion in the light of the fact that the United Republic of Tangania, which is considered to be one of agricultural countries as indicated by Statistics on Import and Production of the United Republic of Tangania, has become a rice-importing Country since 1961 though Tanzania exported rice before 1960, thus concluding consumption of rice in the country is getting increased remarkably these days.

#### Situations of Import and Production of rice

		Quantity (in cental)	Value (in £)
	1965	89,184	210,423
Import	1966	298,992	790,212

Note: 1 cental = 100 lbs.

	1962	33,862 ton
	1963	44,550
Production	1964	47,100
	1965	22,370
	1966	42,190



2. The Government of the United Republic of Tanzania is now preparing the draft of the new second 5 year Plan in which establishment of several State owned farms with large scale are designed as one of the important policies for this term. The Mbarali Irrigation Scheme centering on rice is taken up for its first undertaking of the above said farms in the Plan. Since a technical system of cultivation for sugar cane, coffee, tea, etc. has been so far established on the basis of private estates in use, the Government of Tanzania has naturally to give priority to production of rice. Attention may be drawn to the facts that the direction of the Government of this country coincides with recommendations made out on the matters by various consultants.

b) Integration of Experiments and Reserchs

3. However, the experimental and reserch organizations of this country started its business on improvement of species of rice plants late in 1957.

The team heard that authorities of Tanzania Government asked though mofficial the Japanese Maize Mission, which visited the country last year, the possibility of technical cooperation by the Government of Japan on improvement of rice plant species, but no favorable answer was obtained.

Operation of state-owned farms under planning in this country is to be mechanized in their processes from manual stages of land leveling and seed spraying and measures for increasing of crop yield will be gradually taken year after after.

For the purpose of establishing a mechanized technique of paddy rice cultivation, it is necessary to make a comprehensive promotion of various systematized experiments, but it is considered to take considerably long years to attain.

For instance, in the west coast (the Indian Ocian coast) of the Federation of Malasia, which has the similar meterological conditions (great dry season, great rainy season, small dry season, small rainy season.) to those of the United Republic of Tanzania, rice double cropping has been extending in these days.

It was the beginning of rice double cropping when Japanese experts on rice plants dispatched under the Colombo Plan after the second World War, made success on production of two improved species

called "Malinja" and "Maksuri" at the experimental stations in Malaysia after several trials of experiment for improvement of species. After 1964, sharp extension in this field has been under way.

Establishment of irrigation facilities has been strongly propelled in this country as facilities which play the basic role for off-season rice planting in dry seasons.

In addition to the above, the urgent necessity of water control by irrigation and drainage has been recognized since the short stem species with high grain yield, i.e, I.R.8 (so called miracle rice) was improved by I.R.R.I in Manila.

4. Japan has a short experience in cultivation of paddy rice by large-scale machines and has been entering into a practical stage at the Hachirogata reclaimed land only in these days. It is believed that the experiences obtained through experiments and researches will drying forth available hints and suggestions to the country.

In referring to rice cultivation methods by large-scale machineries in the U.S.A., the method now applied in humid zones of the Texas State has to be studied rather than that of dry zone of the California State from the view-point of meteorological conditions. A rice cultivation method applying pump-up irrigation in the low and humid zones of the Texas State may give a plenty of lessons to the country.

#### 2.1.2. Economic Policy for Establishment of Agriculture Under Irrigation

5. The United Republic of Tanzania is extremely similar even in trade structure to the Federation of Malaysia (whose national income per capita is reported one of the highest in the South-East Asia, following Japan in ranks.)

Products which the Federation of Malaysia has been exporting to foreign countries are centered on two main products, rubber and tin. And in Malaysia, the funds accumulated by exporting rubber, which is the product yielded mainly in the estates as cash crop, has been continuing to be refunded to the development of paddy fields for the possible contribution to improve-

ment of Malaysian's livelihood.

Muda Dam, for irrigation purpose for the Penang City area, are now under construction with the funds advanced by the International Bank for Reconstruction and Development.

Success in double cropping of paddy rice plants and achievement in extension works in the Wellesley Province situated at the opposite of Penang City bank indicates that the technical assistance which Japan has been furnishing for 20 years to the Federation of Malaysia has borne fruit.

6. Mechanized agriculture other product in this country such as coffee, tea, etc. corresponding to rubber in the Federation of Malaysia, on large scale basis have been so much developed that this country is in a position to be able to export coffee and tea products. In this sense both countries are very similar to each other even in a such field. However, the United Republic of Tanzania will be more prosperous in the future than the Federation of Malaysia on the ground that both Tanzania has a quite different production structure, which owes mainly to its land system. Attention should be drawn to the difference in land system between both countries.

The Federation of Malaysia has been developing in success double-cropping of paddy rice plants under the high rate of farm rent (1/3 of yielded harvest) with mobilization of large-scale tractors and chemical fertilizers as well.

On the other hand, a land system in the United Republic of Tanzania conceives big potential of development in the future.

Rice graduation cost can be lessened because cost of land use can be deducted from total cost for rice production. This is considered to cover disadvantageous condition on transportation of products from producing district to exporting harbors.

Under such situations, a prospect of paddy rice plants as cash crop in this country should be highly appreciated in international exporting competition.

In due consideration of the urgent and increasing world's demands of rice especially in recent years, the Government of the United Republic of Tanzania should pay due attention to the importance of production of rice plants.

b) Price Policy

7. It is needless to say that remarkable development in rice production achieved by Japan in recent years owes to her technical improvement. In addition to the above, it should be noted that such development was propelled by an application of the Government particular monopoly system as an economical policy, under which rice price of ex-farmhouse is fixed same regardless of transportation distance and propelled by special tariff rate system in which unit rate of tariff decreases complying with length of transportation.

Due consideration should be paid to the above-mentioned systems which are being applied and conducted in Japan, in preparing and carrying out economical policies such as marketing and so on.

c) Construction Subsidizing Policy

8. It should be noted that for development works of the natural resources in Hokkaido of Japan, which could be compared to the Bukoba region in the United Republic of Tanzania in every sense, a high rate of subsidies by the central government has been extended to the development projects.

In case of decision of land rents in the United Republic of Tanzania and of determination of shares for construction cost to be borne by the farmers, special attention has to be paid for facilitation of assistance to the remoted districts.

In conclusion it should be taken into consideration that a rice price policy, a transportation policy, a construction policy etc. has been maintained by rice cultivation technique in Japan, In other works various measures taken by a such country as Japan have been successfully conducted, focussing comprehensively on the propulssion of rice cultivation.

### 2.1.3. Conclusions

In propulsion of building up a socialist country in the United Republic of Tanzania, the process of technical improvements made in the Federation of Malaysia should be studied, and the experiences of international technical cooperation which Japan has even made, and the process of Japan's economic policies should be deeply taken into consideration.

Development of water utilization for agricultural use in Tanzania will be highly productive and is expected to be one of the main causes which enables the inhabitants of this country to have better living, thus contributing to the economic development of the United Republic of Tanzania.

## 2.2. Power Generation

### 2.2.1. Demand for Electricity

10. With respect to the electric power industry activities in the United Republic of Tanzania, The Tanganyika Electric Supply Company, Ltd. which is abbreviated as "TANESCO", has been carrying out its assignment of electric power generation, transmission of electricity and electric supply under the provisions of the Agreement concluded between the Government of Tanganyika and the Tanganyika Electric Supply Company, Ltd. (TANESCO) under the date of February 28, 1957.

In view of the sharp increase in electric power demands in recent years, TANESCO requested Merz & McHellan Consulting Co., London to conduct the market survey on electric power in the United Republic of Tanzania. The obtained results are shown in detail in the Report on Market Research of Electric Power issued in March, 1964. At present when actual results of 1965 and 1966 were obtained, estimated demands are approximately very close to the actual results throughout the country, but in some districts actual results does not show the expected demands. TANESCO, in the recognition of necessity to reconsider the above results, requested again Merz & McHellan Consulting Co., Ltd. to carry out market research again.

Considering that the estimation of electric power demands are a prerequisite for drawing up a timetable of water resources development projects including electric power in the coming five year Plan, it is suggested to complete the market survey at the possible earliest.

11. At the end of 1966, the output by the power generation facilities is reported 71.645 KW in all in the United Republic of Tanzania; 30.425 KW by hydraulic power stations and 41.220 KW by thermal power stations. The generated electricity (1966) is 252.446.180 kwh.

On the other hands, the population of the Republic of Tanzanyika is 11.876.982 according to census for 1967, Therefore electric power consumption per capita in Tanganyika becomes 21.3 kwh. which situates in lower ranks compared with 165 kwh, the African average (1961) and further this figure is the minimum in comparison with the Republic of Uganda and the Republic of Kenia in the East-Africa whose power consumption per capita is registered 36 and 47 on the average respectively.

These days electric power demands has indicated sharp increase. As a matter of fact electric power sold in 1966 shows the increase by 19%. The future electric power demands is to be estimated on the basis of the results of market research which is now under way by Merz & Mclellan Consulting Co., Ltd. but the team feels almost certain that the consumption of electric power per capita will be doubled within 4 - 5 years and that it will reach at the present average of all Africans within 20 years.

12. After the completion of estimates of yearly electric power demands of this country through market survey on electric power consumption, it is necessary to work out a time table of construction of projects for various facilities to meet the estimated maximum electric power demands for years to come.

The combination of hydro-electric power and thermal power should be determined so as to make the efficiency of the set to the maximum.

The following process of construction of power station may be advisable for such country as is necessitated to meet sharp

increase of power demand.

Firstly thermal power station with big capacity has to be planned considering the fact that modern thermal power station with big capacity produces very cheap power. Then paying attention to what extent a hydro power station to be newly built can meet the power demand, a part of full capacity of the above thermal power is installed so that total capacity of hydro and thermal power station altogether can meet the power demand.

b) Power Development

13. As a link of new hydraulic power generation works in order to cope with sharply increasing demands of electric power in this country as stated above, the Nyumba Ya Munga Dam and Hydro Power Station are now under construction at the upper reaches of the Pangauri River.

In addition to the above, it is said that any one of the hydro-electric power projects for both the Womi River and the Rufiji River is expected to be constructed under the second 5 year Plan according to the results of comparative surveys which is under way by SWECO consulting firm.

Construction of hydro power stations including dams taken considerable periods.

Under such circumstances, it is almost impossible to meet electric demands which is expected to be double in 4 - 5 years in this country by only means of construction of hydro power stations explained above.

Accordingly, additional constructions of thermal power stations are inevitable.

14. Increase in electric demand is the sharpest in the coastal district mainly centering around Dar es Salaam the Capital of the United Republic of Tanzania. Degree of increased electric demand varies year by year and district by district. A daily load patterns of electric power varies with the progress of industrialization of this country.

Judging from the above, the construction of electric power transmission lines now under way along the coastal district is

considered extremely important.

15. In consideration of rapid increase in electric power demand in coming several years, particularly the sharpest increase of such demand in the coastal district, and construction of electric transmission lines and hydro power stations stated above, it will be the best time now to plan the construction of a thermal power station with big capacity in the vicinity of Dar es Salaam in the coastal district and then to establish grid system of electric transmission lines to be linked with the said thermal station after the first stage construction completed.

At present, the United Republic of Tanzania has been importing petroleum as main fuel. Some of electric generators now in operation are of old type with small capacity, and the cost per kwh of thermal power stations is as high as 12 cents in the coastal district.

But the cost of electricity by modern thermal power station, with big capacity is as high as 8 cents only, thus construction of new big thermal power station will contribute to lowering cost as a whole.

16. Once a hydro power station is constructed, there is no need of fuel for operation nor harm to public by smoking.

The United Republic of Tanzania does not produce petroleum, thus a great importance should be attached to the construction of hydro power station.

In these days when peak load fluctuates day by day and time to time if the base load, is covered by electric power generated by thermal power stations and the peak load is met by electric power generated hydraulic power stations, this combination makes operations of both hydro and thermal power stations most effective.

To achieve the above hydro power stations with high dam and big reservoir, which easily meet the peak load, is most effective.



17. The team observes that the rivers in the United Republic of Tanzania have not always favorable conditions for hydro electric power generation from topographical, hydrological view-points. So, In preparation of economically sound development project, the thorough surveys and investigations for each river on topographical and geographical features should be performed on the country-wide scale, as conducted in the Rufiji River Development Project by the Food and Agriculture Organization, It is expected that thorough investigations on topographical and hydrological characteristics would enable preparation of economically sound water resources development project. As a matter of fact electricity in Tanga City, which is supplied with electric power generated by use of the Pangai Fall, costs only 3 cents/kwr, which proves that economical hydro power development can be constructed in this country.

c) International River Basin

18. The United Republic of Tanzania has so many rivers along its boades with neighboring countries. Typical rivers are the Ruvuma River, which flow the border with Mozambique, and the agera River along the boader with the Republic of Uganda, the Republic of Rwanda and the Republic of Brundi.

These rivers are international rivers and development of these rivers involves political consideration.

It is desirable that market surveys on electric somes will be conducted in cooperation with the countries concerned and then development will be put into realization as the joint project with such countries.

Any proposal for establishment of the joint committee and for holding its conferences will be highly appriciative.

(c) Flood Control and Hydrology

19. The team could not perform full observation and surveys concerning damages caused by floods due to its short stay in this country. However, during the stay of the team, the team observed that t the Ruvu River, the Wami River and others had greatly flooded

caused by heavy rainfalls in April, 1968 and further was informed that the maximum water level had recorded in the Wami River in this rainy season.

On the other hand, when the team visited Bukoba situated on the west side coast of the Victoria Lake, the water stage of the Kagera River which runs across the area was observed as the one of average years.

Looking into a part of the records on precipitation which the team could obtain during its stay, the team came to know that the meteorological conditions within territory of the United Republic of Tanzania are fully varied by regions and understood that the flood control plans should be designed to each of rivers in due consideration of locality of the meteorological conditions peculiar to each region.

It can be suggested to receive any advice by meteorologist in this respect.

20. The meteorological records and data, especially on precipitation and run-off are comparatively well prepared and arranged so far. However, there are some lost records or can be observed, and some of records by observation stations in river basins along the border are not obtainable. Therefore efforts to systemize the exchange of records with the countries concerned on the cooperation basis and to file such collected records with bigger scale should be paid.

It should be noted that the collection and filing of hydrological records are the most fundamental matters for formulation of a water resources development plan, especially of a flood control plan.

21. Since the river in Tanzania is characterized by meandering which makes capacity of the river short for accommodating floods, when flood comes it must easily inundate plan's along the river. Therefore excavation of new channels and other measures for flood prevention may ease flood damages.

In Tanzania, where construction of flood control dams costs much more than channel improvement of the ever flooded river due to its topographical and geological conditions, what measure for flood prevention has to be taken should be finalized

after comparative study on dam construction and channel improvement for flood control.

When people dwell and wishes to engage in forming in the future, in the lowlands created by river floodings, it will be necessary to consider how to cultivate the damp lowlands.

The plan decision basing upon economic comparison above-mentioned will be applicable only to the river basins at such stage reached as explained above.

22. It is recommended that the reconnaissance of river improvements for flood control on the country-wide scale be once performed by hydrologists and river engineers in this country.

### 3. Reconnaissance of the Kegera River Basin

#### 3.1. Future Prospect of Development in the West Lake Region

##### 3.1.1. Agriculture

###### (a) Rice

1. Recommendations on paddy rice plants and sugar canes were made in the survey report by Sir Alexander Gibb conducted in 1956. Paddy rice yields of today, after the lapse of ten years since the above recommendations, are still negligibly small in this country and it is now considered that the domestic extension of sugar cane is needless.

However it is a belief of the team that rice paddy and sugar cane are the most profitable crops for cultivation under irrigation as stated in the report by ILACO. Thus it is advised to take up these two kinds of crops when vast arable land is subject to water resources development for new cultivation.

(1) Feasibility in productivity of paddy rice planting is pointed out in the Survey Reports (1961) of the International Bank for Reconstruction and Development as follows;

#### Prospect crop yields under irrigation

	Yields in lbs per acre		Assumed price £ per acre	Yields in £ per acre	
	strict super-vission	moderate super-vission		strict super-vission	moderate super-vission
Cotton (seed cotton)	1,800	1,250	49	39	28
Paddy	3,500	2,250	30	47	30
Onions	2,500	2,000	33	37	29
Ground nuts	1,400	800	46	29	16
Maize	3,750	2,250	14	23	14
Beans	1,250	1,000	25	14	11
Caster seed	1,250	750	28	16	9

Source, The Economic Development of Tanzania  
Table 50

2. Special attention should be drawn to the wide annual fluctuation of run-off of the Kagera River. The Catchment area of this River is very extensive and there are many swamps in the upper reaches of the river.

Therefore, the stream flow of the river is abundant even in June, July and August of the dry seasons.

The above point means that the Kagera River Basin has such advantage that paddy rice, which consumes a plenty of water, could be planted without reservoir even in dry season.

rice plants, ILACO recommended in the Sanjo Scheme (the Rufiji basin) (See table attached before).

Even in the Kagera basin there is feasibility of double cropping of paddy rice plants.

As in the case of the Sanjo the cultivation of paddy rice can be recommended with confidence as observed before in the table of the Survey (1961) by the International Bank for Reconstruction and Development.

3. The indigenous people of this country live on banana, and rice is used in only cases of feast simply because it is considered as a luxurious food. So rice is recommended to produce only as one of cash crop at first.

Since this country has not developed cultivation technique on rice yet, it is considered essential to perform educational and instructional works by building up the pilot forms as well as to conduct extension works in the field. No more than 200 acres are enough for pilot form and such pilot farms should be built up by appropriation of budget for survey on the Kagera River development. Various problems to be expected to take place on rice cultivation will have to be solved before its development start.

Continuous efforts for solving practical problems should be made even after the actual construction works started.

As for labors for rice cultivation, Bukoba area where climate is very mild due to its high altitude has better environment for hard labor than damp lowlands with high temperature.

For the purpose of obtaining excellent results in the pilot farms, the technical cooperation if offered by the Government of Japan and the practical education and instruction conducted

by Peace Corp. Volunteers would be most effective. It is very fortunate for Japan that the inhabitants of this country have a friendly feeling toward Japanese and the activities of Japanese Peace Corp. Volunteers by Women in this country is being well received by them.

In addition to the above, the team observed that the local Bukaba Cooperative Union Ltd. has been performing a brilliant exploitation and is proposing to bear a part of survey expenditures for both 1966 and 1967.

Proposed Cropping Pattern

in the Sonjo Rice Scheme

Recommended by ILACO

Area (acres)	Crop	Remark
750	Irrigated rice 1st crop	long-growing variety
750	Irrigated rice 2nd crop	short-growing variety
250	Irrigated beans followed by follow	
500	Rain-fed rice followed by Sorghum	short-growing variety
400	Rain-fed rice followed by follow	
250	Cotton	
250	Maize followed by beans	interplanted in maize
210	Cashew Perennial	
90	Experimented and demonstration plot	
500	Home-steed plots in villege	

This fact indicates how big is the size of the population pressure, which is a motive power of water resources development and indicates also the time is coming closer toward realization of the Kagera River development project.

Thus various schemes stated above have to be visualized in compliance with progress of the survey in the future.

When the budget for survey on the Kakono Dam is earmarked in the national budget of the United Republic of Tanzania, it is recommended that the pilot farms stated above be built up by use of the allotted budget no matter how small such farms may be, and it is fundamentally important to establish a technical system of rice cultivation before the commencement of the development works.

(b) Sugar Cane

4. When agriculture under irrigation is established, sugar cane, requiring a quantity of irrigation waters, can be chosen as one of the most desirous crops.

Cultivation technique of sugar cane has been well established through the experiences by the traditional estate method.

However, it is reported in the ILACO Reports that there will be no necessity of extending production of sugar cane for coming 20 years for view of the world situations of its production and its domestic demands, and it is recommended that positive policy for cultivation of sugar cane in the Kagera River Basin should be refrained from.

(c) Tea

5. Production of tea in this district has been started in recent years and the statistics show a steady increase, almost achieving target of the 5-year plan.

Tea-picking has been made once a week and even in the dry seasons, once every 10 days all the year round. Accordingly, yields are great deal, which indicates that the meteorological conditions of this district are suitable for tea production.

No irrigation water is needed except the time when transplantation of nursery trees is made and some irrigated water is required. Generally speaking, at present, practically no water is needed to the estate.

The team, having much interest in the irrigation scheme, was asked for informing development situations of the irrigation scheme by the owner of the tea estate.

In a part of the regions where irrigation system is difficult to be established, tea as well as coffee, banana will be most suitable products to its local condition.

### 3.1.2. Power Generation

6. As to the power plant in the Bukoba district, a thermal power plant with a total capacity of 800 KW was constructed in 1965. While the maximum demand in the district in 1966 was 402 KW and the peak of the demand was only 2 to 3 hours during the day centering around the evening with such a very low load factor as only around 47%, the maximum demand in Bukoba in 1966 was 415 KW with a load factor of 52% according to Merz & Mclelloa Report, indicating that the prediction of the report was not a total failure.
7. Forecasting the future power demand, the same report predicts that the maximum demand in 1978, 10 years hence, will be 1,110 KW and that in 1983, 15 years hence, it will be 1,530 KW with an annual increase of about 10%. However, since the Merz & Mclellan Report predict the Maximum Demand up to 1966 and there have not been seen anything that could be the basis for accurate prediction for the year thereafter, political measures on the development of industries will have a great influence as the factor for determining the future power demand. The General Manager of Bukoka Cooperative Union Ltd., in expressing the enthusiasm of local residents for the power development, pointed out the better living and cottage industry as the factor for determining the power demand.
8. As a determining factor for the scope of the Kagera River power Development Project and others the power demand in the southern Uganda may be pointed out. On the Kagera River on the side of Uganda near the border of Rwanda, Kitigati Hydro-electric power station stands with 2 power generating units, each having a capacity of 750 KW and 550 KW, in the total capacity of 1,300 KW. The Kagera River also has relation to three countries, namely, Brunei, Rwanda and Uganda and since the project



we propose in particular has a very close relation to Uganda, making it necessary to make a joint development, it because necessary to draw up a project by also taking into consideration the power demand in the country of Uganda. Therefore, it is recommended that a request be made to Uganda for the establishment of a joint investigation committee.

9. As a determining factor for the scope of the Kagera River power development project, quantity of requirement for irrigation water may be pointed out. Whether the priority is given to irrigation or to electric power is the matter of policy making. In the case irrigation is required and assumption is made that a dam is constructed near Kakono, the area possibly irrigated will be approximately 200,000 acres and the required quantity of water will reach about  $70\text{m}^3/\text{s}$ . On the other hand, if natural flow of the Kagera River is to be utilized in full, use of about  $130\text{m}^3/\text{s}$  is possible and the remaining  $70\text{m}^3/\text{s}$  may be directed to power generation. Of course, a portion of  $70\text{m}^3/\text{s}$ , the quantity used for irrigation, may be utilized after it is used for power generation. Furthermore, if control of river flow is possible by Kakomo high dam, the quantity of water for power generation could be increased to  $200\text{m}^3/\text{s}$ . With the above-mentioned factors taken into consideration, the power development project envisages 1,800 KW for the first phase and 1,800 KW for the second phase, totaling about 3,600 KW.

### 3.1.3. Flood Control

10. The Kagera River basin, like other basins, has low population pressure and residential areas are scattered mainly on the hill. There is no sign that the residents will move to the low land along the river, therefore it may be said there is no need for flood protection at all. However, the Kagera River has on the side of Tanzania two swamps, the Ngono, Ikimba and the Dwrere. If both swamps are to be reclaimed, it means that approximately 65,000 ha of rich plain is nearly born, since the soil is expected to be fertile.

11. These swamps were formed as a result of insufficient capacity of river to flow the water and of geographical reasons. As Alexander Gibb and Partners Co. said in its book "Water Resources Survey", it is considered that the problem of swamp can be solved mainly by embankment works, excavation of new waterways, closure of old river bed, cut-off and closure of waterways which connect the low land to the river bed. This river bed improvement project requires a detailed hydraulic analysis.
  
12. Elimination of swamps from the area on the lower reaches of the Kagera by means of embankment work involves in fact very difficult problems. This is because the water level at the mouth of the river, in other words, the level of the Lake Victoria varies considerably in each year. For this reason, the design high water level of the Kagera River may be set very high depending on the method used for determining the water level of the lake, resulting in high cost of improvement work such as embankment works and opening of new waterways and it is expected that the project would not be economically sound. For example, the highest water level of the Lake Victoria in 1964 was 372.02' and this was 7 to 8' higher than the near valve of the water level for the past 70 years and it is extremely difficult to predict how much it will go up in the future. Therefore, as far as the Kagera River is concerned, the nature of the river is different from those of other rivers that flow into the Indian Ocean and the improvement of swamps by the improvement of river will require a careful and political consideration, more than a mere economic analytical viewpoint.
  
13. It was impossible during a brief period of exploration of the team to determine whether or not the improvement of swamps can be accomplished by controlling the flow discharge with a flood control dam on the upper reaches. Therefore, in the future, accurate water level measurement and hydraulic analysis (For example, present capacity of the river to flow the water, etc.) should be carried out and the size of required reservoir and dam should be determined by consulting topographical survey and hydro-meteorology.

14. In June 1967 a hydro-meteorological survey on the three great lakes on the catchment of the Nile, titled "Hydro-meteorological Survey of Lakes Victoria, Kioga and Albert" was inaugurated on the minimum 5 year plan with the cooperation and assistance of five countries concerned, ie. three east African countries, Sudan and U.A.R. and W.M.O.. The Headquarter of this survey is located in Entebbe and part of Regional offices are located in Bukoba and Mwanza of Tanzania and are presently engaged in the collection of (1) Meteorological data such as precipitation, evaporation and sunshine, (2) hydro-meteorology such as effluence, etc. Also for the Kagera River, a survey on run-off has been initiated with the Bukoba Regional Office in charge of the project and the work has begun to install water gauge in four location; one 18 miles upstream of Kyaka Ferry, one 6 miles upstream of a Junction of the Ngono River, a tributary, and the Kagera, one on The Ruvuvu River and one on the Western Ngono (Mwisa River). This survey data holds an important bearing in that the Kagera River, on international river, is to be surveyed being sponsored by the United Nations and it is hoped that this survey will be used not only for the flood control project but also as a momentum for pushing this project to the point of drafting power generation and irrigation project and also for drafting a joint development project.

### 3.2. Water Resources Development of the Kagera River Basin

#### 3.2.1. Outline of development project.

15. The flat portion of the Kagera River basin contains many areas for possible development (Elevation is from 3,750 ft to 3,900 ft) and these areas may be identified by block as follows.

- A. Area on the South bank of the Kagera; 12,000 ha, elevation:  
3,800 ft to 3,850 ft.
- B. Area on the right bank of the Kagera; 12,000 ha, elevation:  
3,850 ft to 3,900 ft.
- C. Minziro 30,000 ha, elevation: 3,750 ft to 3,800 ft

- D. Ngono Ikimbo Swamp; 15,000 ha, elevation:  
3,750 ft to 3,800 ft.
- E. Dwerere Swamp; 15,000 ha, elevation:  
3,750 ft to 3,800 ft.

These areas for possible development have a total land area of approximately 84,000 ha and in drawing up a scheme for the development of these areas, it is necessary to make a complete study on such problems as flood control, topography, soil, distribution pattern of precipitation and irrigation and water supply.

### 3.2.2. Problems on Flood Control

The problem that has a close relation with the development of the Kagera River basin in particular is the problem on the development of swamps along the river.

These swamps may be divided into the following groups.

- A. Swamps on the midsection of the river.
- B. Ngone, Ikimba Swamp on lower reaches.
- C. Dwerere Swamp
- D. Swamps around The Lake Victoria.

17. The Kagera River, with a total length of 750 KW, runs north after passing Rwanda and Burundi, then runs eastward near the border of Tanzania and Uganda and flows into the Lake Victoria. Annual precipitation in the catchment area is from 1,707.3 mm to 2,734.5 mm (in Bukoba during 1951 through 1963) and the catchment area includes areas of relatively high precipitation and the annual run-off is about 10 billion cubic meters.
- The weather in the catchment area is represented by dry season (from June to September) and rainy season (from March to May) as characteristics with the tropics and in proportion to this phenomenon the condition of the river is divided into the drought season (from October to March) and a high-water season (from April to August).

The past record indicates that the minimum discharge observed at Kyake during 1959 through 1967 is about  $130 \text{ m}^3/\text{sec}$ . and the flow less than about  $100 \text{ m}^3/\text{sec}$ . has never been experienced even if extending observation period to the past. In high-water season the flow discharge of about  $250 \text{ m}^3/\text{sec}$ . continues for about four months.

18. According to the report of Water Resources Survey of The Nile Basin in Tanganyka, the annual rate of run-off is approximately 8%. This is because the swamps on the midsection and in the catchment area are functioning the role as flood control and the evaporation from the water surface is decreasing the run-off. The control of water offered by these swamps, on the other hand, contribute to the stability of the run-off and this is why the river has a very stable flow condition with a maximum and minimum flow ratio of 4 to 5.
19. It is advisable to make a use of these swamps, which are functioning as the device for flood control on the midsection, though they involve a border problem with Burundi and the evaporation from their vast surfaces is disadvantageous from the standpoint of water resources development, as a natural control facility of flow, and to retain the possibility of development until a demand for the development of water resources in the Nile basin arises in the future, since there is no particular necessity for the increase in the water resources at present.
20. The development of swamps below the point of Kyaka ferry is closely related with the problems of flood control, and in order to decrease the difference between the flood discharge (high-water run-off) and the drought discharge on the river flow which has a low max-min. ratio, very stable in high-water season and which also maintains a continuous flow for a long period, the control by means of a dam can be considered. However, in this case the capacity of the dam required will be tremendous (about 10 billion  $\text{m}^3$  calculated on the flow during 1963 through 1964), therefore this method is not recommended at this stage.

21. As to the causes of formation of the Swamps around the Lake Victoria, Ngono, Ikimba Swamp, Dwerere Swamp, the swamp around the lake presents the form of a swamp because there is little difference between the water level of the lake and the elevation of the ground. Control of water level of the lake and the establishment of embankment, drain gates and draining facilities will make the development possible and the method of development should be decided after the maintenance of future water level of the lake has been estimated based on the past like water level. Elevation of the ground at Dwerere Swamp is 3,750 ft to 3,850 ft and the terraia has a very easy gradient of 1/3,500 and it is necessary to determine whether the formation of the swamp is due to the outflow from the Kagera River or to the poor drainage of rain water in the area. In the case of the improvement of the Kagera River, estimation of outside water level, particularly that of flood water level with the Lake Victoria as its basis, becomes a very important question coupled with the estimation of design flood and the excavation of new waterway and in turn determines the possibility and the scope of the development of the swamp.
22. Ngono, Ikimba Swamp involves a problem of being affected by water level of the Ngono River, a tributary of the Kagera River, which also is influenced by the water level of the Kagera River. In this district swamp is formed on the ground with the elevation ranging from 3,750 ft to 3,850 ft. The difference in flood water level at the Junction of the Ngono and the Kagera can not be determined at present because of indistinct distribution of precipitation and pattern of flood run-off. Since the water level at this Junction holds the key to the development the Ngono Ikimba Swamp, estimation of water level at the Junction subsequent to the improvement of the Kagera and the estimation of the change in the flood run-off subsequent to the development of the region around the Ngono are important, on which a drainage project for the swamp area should be drawn up.
23. Judging from this point of view, it is considered that the improvement of the river channel of the Kagera deserves a future

study. Because of the relation of the main stream of the Kagera with its tributary, it is ideal to decrease the peak by giving a priority to the drainage of the discharge from the tributary. However, the effectiveness of drainage of the discharge from the tributary is not considered to be promoted unless the drainage to the Lake Victoria shows its effectiveness.

### 3.2.3. Geographical problems

24. Existing cultivated area in the Kagera River basin is maldistributed to relatively high ground and what left for possible development are the swamps and the vast plain in the form of a Savanna. Each of these areas is a complete flat land, having no restraining factors for the development work, such as slope, crease of ground surface and there is no geographical restriction if large scale mechanization of farming is to be projected. However, because of its flatness and vastness, this area still has an unsolved problem of water distribution and drainage.

25. When dealing with irrigation farming, there remains a problem of elevation. Since the right bank of The Kagera River (elevation of 3,850 ft to 3,900 ft) requires water level 50 ft higher than that of required for other areas, the location and the method of water intake require a close study.

For the rest of areas there are no particular disadvantageous factors for irrigation.

Though there is still a problem on the treatment of water drainage in the area on the lower reaches of the Kagera because of predominant flat land, the possibility of drainage becomes an important question for the development of swamp where the ground has a gentle slope.

### 3.2.4. Soil problems

26. Since the soil in the swamp area consist mainly of peat and clayey, improvement of drainage system may have possibility of shrinkage of ground due to organic decomposition of soil and con-

solidation. Since this phenomenon in fact, can also be the cause of ineffective drainage, there is a need to take a measure for the improvement of the swamp area by estimating the degree of corrosion and decomposition and the progress of the sinking or change of the ground. Generally, the swamp area has many possibilities of becoming a flat damp area even after improvement is made, therefore the crops that are suited to this area will be rice, sugar cane and grass.

27. Soil in the savanna area is of mild alkali and contains many silt and has relatively low water permeability but the soil is not fertile and if improvement is made on water supply, there will be a little restriction as to the type of products. As for the type of crops, rice, sugar cane and others are being considered and the rice, which is the irrigated product, is particularly suited and the form of small paddy field with little water permeation will be an important factor for water utilization.

#### 3.2.5. Problem on the distribution of precipitation and irrigation.

28. The weather condition in Tanzania as a whole as well as in the Kagera River Basin, as characteristics with the tropics, is divided into dry season and rainy season and the precipitation shows a considerable maldistribution. Appropriate distribution of precipitation is very advantageous for the cultivation of crops and particularly Judging from the temperature and humidity in this tropical zone, it is considered that there should be relatively high evaporation and dissipation. In this region, however, because of little fluctuation in the temperature and humidity, there can be no major change in the quantity of evaporation and dissipation (depend on surbeam temperature, atmospheric temperature, precipitation, wind, etc., and the prediction is difficult due to the lack of data) throughout the year, then the quantity of water required will be as indicated on the following table.



(Unit: mm)

Drops	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.
Rice	372	310	386	310	300	-	360	310	310	300	310	-
Sugar cane	186	188	168	186	180	186	180	186	186	180	186	180

(Assumption is based on the record in Japan)

The amount of precipitation on the Bukoba in the period from March through May, which is a rainy season, is considered to be sufficient in respect of the quantity of consumption.

29. Also in dry season, though the amount of precipitation is extremely small, there is little requirement for irrigation of coffee, grass and pulse. Irrigation for tea and banana at the time of extremely dry weather will bring better results but it will be questionable in respect to the efficiency of investment. As for the sugar cane, the production goes up to 170 to 180 t/ha or more when irrigated in comparison to 100 t/ha when not irrigated, therefore the irrigation in this case is considered advantageous.

It can be said that this is because the effect of irrigation in dry season has a considerable advantageous influence in this case. As for the rice, when considered from the standpoint of evaporation and dissipation there is no great need for irrigation in rainy season, but when the quantity of underground permeation and also the quantity required in the seed planting period and in the initial stage even in the direct plantation method are taken into consideration, a need will arise for irrigation.

30. As to the crops of high land productivity, rice is considered fairly profitable and particularly if double cropping method is introduced and if appropriate cultivation technique is employed based on the distribution of precipitation, rice production in this area will become much more profitable. The effective utilization of irrigation facilities may add profitability of rice production.

31. Although there is maldistribution in the precipitation, it will be necessary to make a further study on the proper plantation complied with the distribution of precipitation by selecting appropriate crops in their rotation, such as the crops of moisture resistance (Moize, etc.) in rainy season and the crops of drought resistance (Sweet-potato, bean, etc.)
32. Whether rice is the appropriate crop or not is under experiment in the laboratory and the findings of the experiment should be fully utilized.

### 3.2.6. Problems on water resources

33. The minimum discharge of the Kagera River is about 130 m<sup>3</sup>/sec. and the total discharge in a year is estimated at about 10 billion m<sup>3</sup> as stated before. The Kagera River, as the source of water, is in the state of undeveloped and has many possibilities of being utilized by power generation, agriculture, industrial water, but for the time being, it will have to be used for agriculture and power generation. With regard the power generation, as far as Tanzania is concerned, the river has a gentle slope which in turn makes it difficult to utilize high head, therefore low head generation with use of plenty of water must be more advantageous.
34. There are many possible sites for power generation near the border of Uganda and Rwanda on the upstream, where head is easily available and Rusumo Falls and Murongo Gorge are particularly suited for power generation. Moreover, since this river has a max-min flow ratio of 4 to 5, there is little requirement for control on discharge by means of water storage. Therefore the question is confined to the question of how the high head is obtained.
35. As for the water for agricultural use only water that has been utilized so far is the irrigation water (3,000 acre) for sugar cane in the Kyoka Estate and there are still plenty of undeveloped water resources.

The land that can be developed for agricultural use by the development of river totals about 80,000 ha for the time being and even on the assumption that the whole area is covered by this irrigation project, the amount of water required is around 100 m<sup>3</sup>/sec., which fully justifies the feasibility of the development with the existing minimum discharge of the river and the irrigation by use of water intake without big facilities becomes possible, thus necessitating no employment of irrigation by water storage system, then the location of water intake and the method of conducting water will become a definite problem.

36. In respect to water level of intaking of water, the swamp area on the downstream can be irrigated with water drawn from water level of the river without water intake and for the lower reaches of the Kakono. the intake method by use of dam or pumping up may be considered for heightening of water level.

### 3.2.7. Designation of Area for Development

37. The area to be developed in the Kagera River basin is as vast as approximately 80,000 ha and a study of aforementioned problems in each area indicates that whether area to be explored is easily suffered from flood damage or not has the greatest effect in determining the priority of development. For this reason, the flat land in the form of Savanna, the land near Kakono on both banks of the Kagera, rather than the area which present the state of swamp at present, will be given first priority for development, and further from the standpoint of geography and water utilization, it is considered appropriate to give priority to left bank.

Considering the improvement of the swamp area is made possible by the flood control project for the Kagera River, a study should be made on the designation of the area for development considering the water level of The Lake Victoria and The River Improvement Project for the Kagera River, based on the findings of the future survey. As for the Mwisu River Basin, because of its very low run-off construction of a dam in its own catchment area and the storage of water during high-water season may

be considered, but it deserves for studying to secure required quantity of water by drawing a part of water from the main stem of the Kagera and to draw up a development project in the Mwisu River Valley in line with the a power generation scheme in the vicinity of the Rusumo falls. This project requires a further study.

38. Besides the above, Ngono Ikimba Swamp, Dwerere Swamp and Minziro forest may be mentioned as the area for development but it is considered they should be left for development after the first stage project is completed.

### 3.3. Kakono Dam Project and a plan for New Project.

#### 3.3.1. Kakono Dam Project

The Kakono Dam Project calls for the building of a dill type dam suitable for the construction of reservoir with vast area to be impounded at about 160 KW upstream from the mouth of the Kagera River in order to develop water resource of the Kagera River Basin for flood control, power generation, irrigation, etc., by utilizing water storage of the reservoir. A study of the problem on this project by reconnaissance of the team on the spot and analysis of data available has brought the following results.

##### (a) Irrigation water

Discharge of the Kagera River is estimated at around  $130 \text{ m}^3/\text{sec}$ . in the least in drought at Kyaka (recorded during a period from 1958 to 1967). The quantity of water required for the area possible for development, approximately 80,000 ha, in the catchment area, is about 100 to  $120 \text{ m}^3/\text{sec}$ . and this quantity is considered sufficient if competition with power generation is not taken into consideration. In addition, when the availability of tributaries, the Ngano and the Mwisu, are taken into account (estimate is difficult due to the lack of data), it is considered there is still enough room. The areas that compete with power generation on water utilization are the area on both right and left banks of the Kagera River and for the remaining areas, utilization of flow after it is used for power

generation or the flow of tributaries is possible, thus eliminating the necessity for the storage of irrigation water.

Therefore, there is no necessity for relying on the high Kakono Dam for irrigation water.

However, since the elevation of the irrigation area is higher than that of the water level of the Kagera River, it is necessary to provide an intake dam to heighten required water level and it requires a further study on the feasibility as to the location of the dam, level of water intake, method of water intake etc. from both technical and economical standpoint.

(b) Problems on Flood control

The purpose of the flood control project for the Kagera River is to develop vast swamps on the lower reaches, therefore it is necessary to develop a measure which requires a small expense for flood control from the standpoint of profitability.

As to the measure to eliminate the possibility of flood and inundation, there are many methods such as water control by means of dam and deversoir, improvement of river by improving the channel, gradient and the width of the river and the combination of these means, but what method has to be taken is a serious problem from a technical point of view. Generally speaking, when the max-min. flow ratio of a river is small, improvement of river is more advantageous than the control method by use of dam, etc. (this is subject to change depending on the lough of the river to be improved).

The Kakono Dam Project provides a means to control flood flow by use of a dam and when the max.-min. flow ratio for river is small (4 to 5), and when the discharge has a cycle once in a year in both drought season and high-water seasons and when the high-water season continuous for several months, the reservoir for flood control will require big capacity.

In construction of this kind of maximum discharge which will not inundate the swamps on lower reaches called safe discharge hereafter is a question to be studied. Estimation of this safe discharge and of the capacity of the dam during the period from 1963 to 1964, based on the past record in the same period above mentioned (the worst year in the past) show the following results.

- A. In the case safe flood discharge is assumed  $300 \text{ m}^3/\text{s}$ . the quantity of storage is about 3.6 billion  $\text{m}^3$ ,
- B. In the case safe flood discharge is assumed  $250 \text{ m}^3/\text{s}$ , the quantity of storage is about 6 billion  $\text{m}^3$ ,
- C. In the case safe flood discharge is assumed  $200 \text{ m}^3/\text{s}$ , the quantity of storage is about 9 billion  $\text{m}^3$ .

Furthermore, if this controlled storage water is released in the drought season, it will be difficult to keep the some of present drought quantity and the discharge of stored water below the safe flood discharge. Then it follows that, it is impossible to completely eliminate the possibility of floodening by use of dam above and it becomes necessary to improve lower reaches of the river even if high dam for flood control built. Under the existing river condition, safe flood discharge of around  $200 \text{ m}^3/\text{s}$ . is considered appropriate. In that case general features of the dam will be as follows:

$H = 55 \text{ m}$ ,  $L = 2,187 \text{ m}$ ,  $T = 90,000,000 \text{ m}^3$  Elevation of water level 4,000 ft,  $Q = 9 \text{ billion m}^3$ , Discharge =  $200 \text{ m}^3/\text{s}$ .  
 Cost of the project is about \$100,000,000.-

If the river improvement project is to be employed, it will be necessary to study such important problems as the route of the river, the question of the short-cut, the question in relation to the water level of the Lake Victoria, the gradient, change in the discharge by control, the maintenance of the route of the river, the questions concerning the water level of the Lake Victoria and the drainage in the area. It will be extremely difficult to draft such a plan with the data available at present. However, if assumption is made that the design flood discharge for river channel improvement is around  $1,000 \text{ m}^3/\text{s}$ , the cross section is expanded and improvement is made on the river channel, implementation of the river improvement project will be possible with the cost estimated at \$16,500,000.-.

(c) Power Generation

Even if the power project with the utilization of the Kakono Dam is established, since there will be a restriction imposed on the maximum discharge to around  $200 \text{ m}^3/\text{s}$ . because of consider-

ation on flood control as stated before, advantages by water control, by the dam is very small the quantity of control, v.e. quantity discharged for power generation  $200 \text{ m}^3/\text{s}$  - drought quantity  $130 \text{ m}^3/\text{s}$ . = Quantity regulated by stored water  $70 \text{ m}^3/\text{s}$ ), therefore there is little requirement for the control of the flow. Power generation with use of dam is about 50,000 KW.

The above calculation shows a tremendous figure and it can be said that this power generation is excessive even when the demand in this area at present and in the future and the demand in Uganda and Rwanda are taken into account. Therefore, it can be said that the power project with the use of Kakono high Dam is still premature under the present circumstances.

In spite of the above said study, whether Kakono project is appropriate or not as a project for today and for the future and whether it is appropriate or not as a schedule of the development project in this country may require further political consideration.

### 3.3.2. Draft of Project to be proposed

On the Kakono Dam Plan, a study was made on flood control, power generation and agriculture (Irrigation) in respect of technique, indispensability, feasibility, profitability and economy as previously mentioned. However, as to the facility for the development of the Kagera River basin, the plan other than Kakono Dam can also be considered. Therefore, we made a study on alternate plans in the following.

- (1) Power project should be drawn up after power requirement is determined in compliance with the demand (estimate for the future).
- (2) The area to be developed for agricultural use in the The Kagera River Basin should be classified according to technical feasibility, utility and economy of each area for priority from the standpoint profitability and then irrigation water should be supplied to the area thus classified.

- (3) As to the flood control measure for the Kagera River, a river improvement plan, which is considered to be advantageous under the existinting circumstances, may be adopted.

As to the overall integrated development project of the Kagera River, a study will have to be made on the basis of integrated plan, paying attention to the balance between each factor.

A schedule for the development has to be established and the project will have to be divided into the first and second phases according to the degree of technical feasibility, utility, economy and dispensability of the work.

(a) The first stage

- (1) Power project by use of low intake dams

Power generation	1900 KW
Quantity of water used	5 m <sup>3</sup> /s.

- (2) Irrigation project for the area on the left bank of the Kagera

Area	12,000 ha
Crops	Rice and sugar cane

(b) The second stage

- (1) Flood control of the Kagera River

- (2) Irrigation project for the area on the right bank of the Kagera River (Kitengle) and Mingiro Forest.

- (3) Drainage improvement project and irrigation project for Ngono, Ikimba Swamp and Dwerere Swamp

- (4) Increment of the power generating capacity

Total power generation	7,700 KW
Quantity of water used	60 m <sup>3</sup> /s.

- (5) Dam and power project for Rusumo Fall and Murongo Gorge on the upper reaches.

Following is the conception of the first stage described in detail.



(c) Details of the first stage

(1) Power scheme

As to the present power supply scheme for the area west of the lake. The maximum demand for a 10 year period from 1968 to 1978 is estimated at 1,110 KW. According to the survey made by Merz and McLellen Consulting Co., Ltd. in 1964, existing power generating facility at Bukoka is 800 KW (thermal) and the increase of 300 to 400 KW is expected in the next 10 years. This increase in the power supply is expected to be directed toward the better living of the residents home industry. Therefore, as far as the power scheme is concerned, if considerable expansion in demand is to be expected, development of power around 1500 to 2000 KW should be sufficient for the time being. In order to obtain the head for power generation, the intake barrage (15 m head) for irrigation will be jointly made use.

Utilization of the flow of the Kagera for power generation may conflict with irrigation water in some respect. The quantity required for irrigation water including future project, is about 15 m<sup>3</sup>/s. for the left bank of the Kagera at the most about 15 m<sup>3</sup>/s. for right bank (Kitengele) and about 40 m<sup>3</sup>/s. for Mingiro Forest, totaling about 70 m<sup>3</sup>/s. Assuming that the discharge of the Kagera River in dry season is 130 m<sup>3</sup>/s, the quantity available for power generation will be about 60 m<sup>3</sup>/s and then the power generated is roughly estimated 7,700 KW.

However, according to the forecast of the demand of the above-mentioned power scheme, about 1500 to 2,000 KW will be sufficient and the quantity of intake water is set around 15 m<sup>3</sup>/s, thus producing power generation of 1,900 KW.

This figure will be sufficient for power supply.

(2) Irrigation scheme

As to the agricultural development, irrigation scheme for 12,000 ha in the area on the right bank of the Kagera, which is most profitable in respect of technical feasibility, utility and economy from the standpoint of flood control, geography and soil, will have to be established.

Under this project, present savanna area will be explored, and about 15 m<sup>3</sup>/s of irrigation water will be taken from the Kagera River by means of intake barrage (Joint facility with power

generation) and irrigation water will be lead to the reclaimed land in the area through open waterway. Outline of this project is as follows:

Area: 12,000 ha Elevation 3,800 ft to 3,850 ft

Crops to be cultivated: Rice, Sugar cane, beans, etc. The project tentatively calls for the cultivation of rice for the entire area.

Irrigated crops: Rice, sugar cane

Quantity of irrigation water

		(Unit: mm)					
	(Month)	Dec.	Jan.	Feb.	Mar.	Apr.	
Rice	First crop	372	310	280	300	300	
	Second crop	Jun.	Jul.	Aug.	Sep.	Oct.	
	Second crop	360	310	310	300	310	

		(Unit: mm)					
	(Month)	Jan.	Feb.	Mar.	Apr.	May	Jun.
Sugar cane		186	118	186	180	186	180
		Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
		186	196	180	180	186	186

Quantity of irrigation water:  $15 \text{ m}^3/\text{s}$ .

Effective rain water: 80% of the precipitation

Main facilities.

a. Water intake facility  $H = 20 \text{ m}$ ,  $l = \text{about } 300 \text{ m}$

Quantity for intake  $15 \text{ m}^3/\text{s}$ .

Joint use with power generation:

Quantity of intake for power generation  $15 \text{ m}^3/\text{s}$ .

(Location of dam: approximately 3 km up the site of Kakono)

b. Raceway length 15 km

c. Irrigation canal in the area

d. Drainage in the area



(5) Flood control

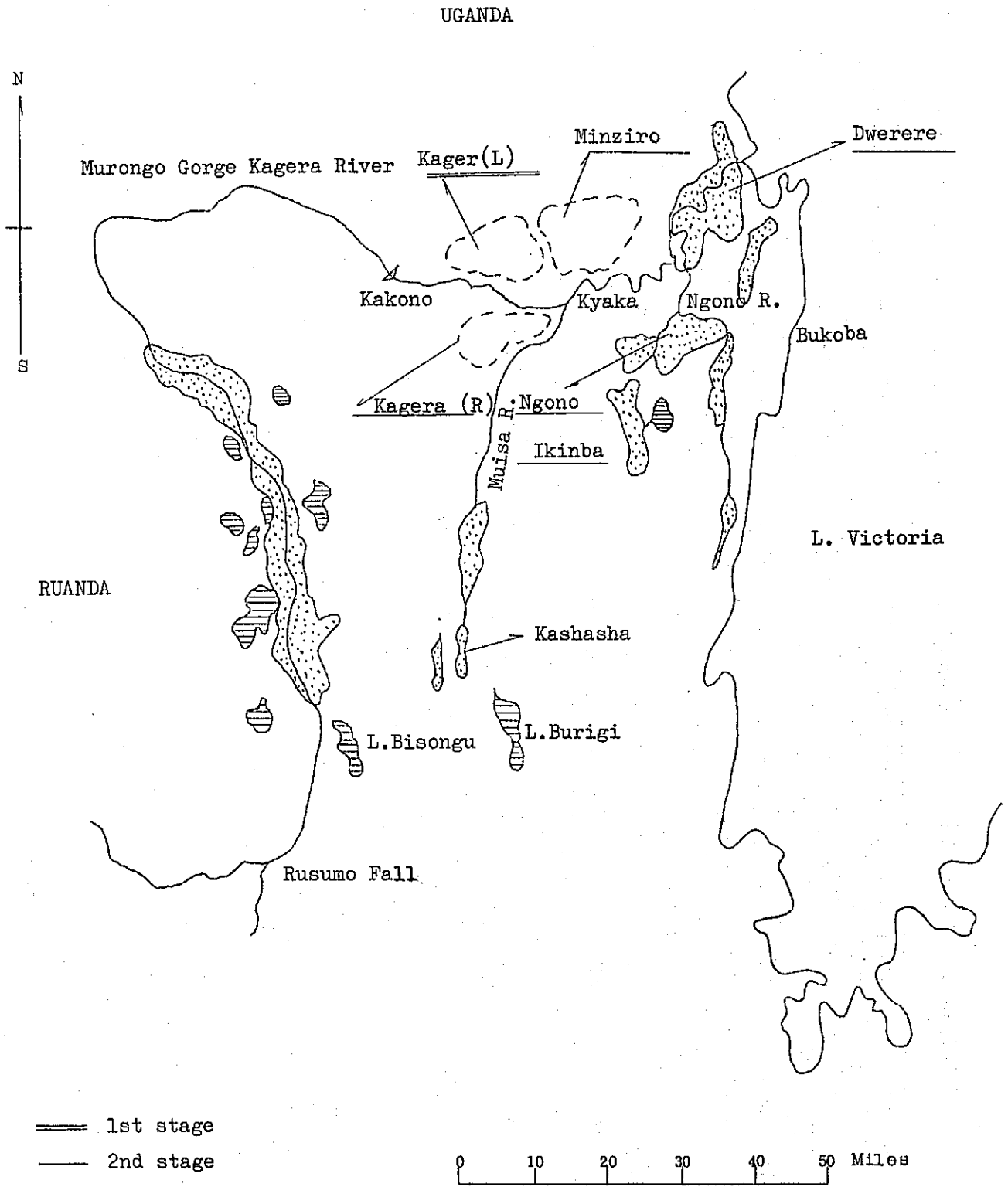
Under this proposal a river improvement scheme is adopted for flood control measure instead of a dam construction and in order to make this flood control measure a success, close observations and survey on hydrological and geographical elements should be made in connection with determination of the location of river route, gradient of the river, the current velocity, treatment of short-cut, designed water level (Determination of water level is particularly important because of the relation between the Kagera River and the Lake Victoria), the design flood discharge, treatment of tributaries, etc., and the project should be drawn up based on the findings of these observations.

In consideration of the above stated facts and the necessity and the economy of the improvement of swamp, it is proposed that the implementation of a part of this project be delayed until the time comes for the second stage. In the meantime investigations necessary for the establishment of an reasonable project (water level, in-flow and out-flow of the Lake Victoria, distribution of precipitation in the Kagera basin, flow and water level at the junction of the Kyaka and the Ngono, area of swamp and the function of swamp against the flow and the condition of flow of the tributaries and so on has to be vigorously carried out, envisioning the state when the flood control measure and the development of swamp are implemented.

LONG RANGE AGRICULTURAL LAND DEVELOPMENT PROJECT FOR THE KAGERA BASIN

Name of Area to be Developed	Land Area to be Developed	Elevation	Crops Irrigation method	Facility project necessary for Development work	Remarks
Left Bank of The Kagera	12,000 ha (30,000 acre)	3,850 ft - 3,800	Rice Sugar cane	Intake dike Raceway Irrigation canal and drainage Land development	First project
Right Bank of The Kagera	12,000 ha (30,000 acre)	3,900 ft - 3,850	" "	Raceway Irrigation canal and drainage Land development Pumping equipment	Second project
Ngono, Ikimba Swamp	15,000 ha (37,000 acre)	3,800 ft - 3,750	" "	Raceway Irrigation canal and drainage Land development	Second project
Dwerere Swamp	15,000 ha (37,500 acre)	3,800 ft - 3,750	" "	Raceway Irrigation canal and drainage Land development	Second project
Minziro Forest	30,000 ha (75,000 acre)	3,800 ft - 3,750	" "	Raceway Irrigation canal and drainage Land development	Second project
Total	84,000 ha (210,000 acre)				First project 12,000 ha Second project 72,000 ha

MAP OF KAGERA BASIN



### 3.3.3. Conclusion

As the additional profitable development project for The Kagera River, power generation with the utilization of the head at the site of Murongo Gorge and Ruzumo Fall on the midsection and the upper reaches may be considered. In the case of Murongo Gorge, advantages are that the gradient of the river channel is steep, that the drought discharge is rich, that there is no confliction particularly with irrigation water and that the flow is stable. Since the construction of an intake dam, single waterway and low dam is easily accomplished at this site and the power generation of about 7,000 to 8,000 KW is possible because of the availability of the difference of the head, there should not be any problem in respect to technical feasibility and utility. However, recent survey revealed that there was almost no data on hydro-meteorology same as in the case of Ruzumo Fall, therefore, it is necessary to make a survey on hydro-meteorology in the future.

In the case of The Ruzumo Fall, existence of natural falls and the utilization of the head is said to be very advantageous. Available amount of water is abundant because of the Junction of The Ruvuvu River and The Kagera River and even in the case that the natural head is utilized for power generation, the demand in all areas of Runwanda, Uganda and Tanzania, belonging to the Kagera River Basin, should be adequately met for the time being.

Although it is presumed that there is a possibility of constructing a huge dam in this site Judging from the geographical location and geological condition, drafting of such project will be decided from the standpoint of power demand.

Moreover, both project involve border problems and if the project is to be shaped up just for Tanzania itself, it is presumed that the border problem will become an issue.

For this reason, on the development of the area up the mid-section of the Kagera River, it is necessary to have a full consultation with related countries on the policy for the survey, establishment of project and the prospect of future demand for power in each country, and the preparation of the project should be based on the findings of the consultation.

Besides the above, in mapping out an irrigation project, for the area along the Mwisu River, development of which is difficult because it is not a perennial river, the possibility of diverting the water from the Kagera to The Mwisu River basin may be considered in conjunction with development at the Ruzumo Fall, but the compilation of data on hydro-meteorology of the Mwisu River is the matter to be settled first and after this the economical soundness of the project should be studied. Under the present estimate the project cost for diverting water to the Mwisu basin will amount to a considerable sum and it is considered there are considerable unsettled problems remaining on the aforementioned agricultural development project which has a low productivity. In progressing a future survey on the development of the Kagera River, the following points should be taken into consideration. If emphasis is placed on the realization of the project, the work in the first stage of the project which we had proposed, may seem to be easily realized but if it is by the high dam project, at least four years are required for the survey and preparation and if additional necessity for project coordination with Uganda is taken into consideration, there is a possibility of a delay in the start of the Second 5 year development project against the wish of the Tanzania Government. Therefore, a detailed comparative survey should be made on both development projects and the decision should be made on the selection from political standpoint of view. Also, it should be added that the financing of fund required for the project may have a conclusive and decisive factor.



#### § 4. Organization of the Water Development Council

1. Any water resources development project includes various element scheme such as flood control, irrigation, power generation, drainage and sometimes even navigation and fishing. Considering that water resources of any river basin is to be explored to its maximum potential for the benefit of the nation, co-ordination of each element scheme becomes essential since it is almost impossible to meet the demand of each element scheme to be undertaken for a basin when potential is limited.
2. Each scheme as mentioned above, on the other hand, has to be under control of various Ministries for its administrative reasons. Each Ministry is necessitated to conduct survey, investigations, plannings, execution and maintenance of each element scheme in-as-much as this element scheme is considered to be pertinent specifically to the Ministry. For instance, in the United Republic of Tanzania, like any other country, the Ministry of Commerce and Industries is responsible to meet power demand of the nation partly because power is considered essential for industrialization of the country as well as the fact that the Ministry controls TANESCO as a body for the execution of power development. Hence, the necessity for the establishment of a co-ordination machinery is observed.
3. In 1966, the Agency for Industrial Development of the United States of America dispatched a three-man team to the United Republic of Tanzania to make a reconnaissance examination of the Rufiji River Basin and published a report of 'Rufiji River Basin' in March 1967. The report includes various recommendations related to the water resources programme of the Government of the United Republic of Tanzania as well as the Basin consideration.  
Establishment of a National Water Resources Council is one of those recommendations which our team also considers a definitely useful one for the successful implementation of Water Resource Development in Tanzania.

4. The idea of National Water Resources Council as suggested in the report is to centralise direction of the planning effort only on a national basis. The Water Resources Council suggested superimposes a basin planning organization upon present governmental administrative structure without superseding vital lines of execution and control. The advantage for the establishment of the Water Resources Council is that the Council would function as a policy-making board for co-ordination of water development planning and could accomplish its objective with minimum additional personnel thus avoiding any additional financial burden on the Government of the United Republic of Tanzania and may not be difficult to obtain although the number of such personnel available is limited.
  
5. Recognizing the importance of coordination of water resources development planning, the United Republic of Tanzania, in this connection, has enacted the Ordinance for establishment of the National Water Resources Council dated February first, 1968. According to the Ordinance, the function of the Council is defined as follows;
  - (a) To prepare or cause to be prepared development plans for the river basins of Tanganyika and project feasibility reports in selection thereto and to make such plans and reports available to the Government;
  - (b) To advise the Government generally on the utilization and development of the water resources of Tanganyika.
  
6. The Ordinance afore said defines staff and service of the Council as follows.

The Council may from time to time,-

  - (a) Appoint on such terms and conditions as it may think fit such officers and servants as it may consider necessary for carrying out its functions under this Act; and
  - (b) Enter into arrangements with persons, firms or agencies for the supply of services or facilities and for the performance of such surveys and other investigations,

including the detailed preparation of river basin plans and project feasibility reports, as the Council may consider necessary.

7. It is one of the fundamental issues to decide what staff should be included in a Secretariat machinery of the Council to enabling it to accomplish its objective as mentioned above. There might be two types of approach to the issue. One would be to recruit specialists such as Hydrologist, Geologist, Soil Scientist and Agronomist as recommended by the above said report of U.S.A.I.D. so that they could assist the Planning Director to co-ordinate the planning of water development project while the other would be, as the Mission thinks desirable, to recruit a few Civil Engineers as Co-ordinators for each river basin project.
8. The former certainly has many advantages. Each staff may give good suggestions or views from the standpoint of his respective speciality. Considering, however, that the main purpose of the establishment of the Water Resources Council is, as Mr. Collette describes to ensure co-ordinated planning for all interests concerned and to give the authority for the execution of proposed river basin project, Secretariat machinery for the Council will have to be composed in a way so as to be in accord with such objectives. It should be noted that the function of the Council is not to draft the planning of water development by itself.
9. Tanzania is on the way to complete country-wide mapping, hydrological net-work and soil survey as well. These fundamental country-wide surveys should be carried out by a single organization as it is. Because the number of specialists available is limited and the Council is supposed to be a super-structure of water resources development organization and not to carry out and maintain all of the above-mentioned fundamental survey by itself, it is doubtful if the recruitment of specialists as staff of the Secretariat is the best way.

10. Should we stand on the above viewpoint, it might be one way to transfer every division under various other Ministries, which is responsible for these fundamental survey, under control of the Water Council. This idea will however, no doubt, spoil the present line of administration of each Ministry concerned, which is not recommended. Thus the best way to do is for the Council to maintain a few Civil Engineers qualified in hydro-power generation, irrigation, flood-control engineering and so on, who would not only act as Secretaries for various river basin but also give their own view from their respective specialised field on any development planning to the Planning Director. The Council can decide the priority for each of the planning by referring to the Secretariat all such information and data for comment and compiled by the Secretaries.
11. In order to achieve the functioning of the Council, which is to ensure co-ordination of all interests concerned, the Secretariat should compile and maintain data necessary for examination of a river basin development project i.e. meteorological, hydrological, geological data including soil survey and so on. For this purpose, it is suggested that each of the Civil Engineers in the Council be assigned to cope with each field. He may afford to do it though his main duty will be the coordination of the plan because what he has to do is just filing of these data which should be obtained from other Ministry in-charge in due course.
12. Thus it is concluded that the Secretariat machinery should maintain small staff qualified in civil engineering, each one of who should be specialized in various fields of engineering concerned with water resources development. The Secretariat should be responsible to file and maintain fundamental data, then to examine and coordinate the planning of water resources development with a view to enabling the Planning Director of the Council to submit every necessary information and data to the Council.

13. In case discrepancy on the planning of water resources development is observed among some of the interests concerned, negotiation between those interests has to be held officially. For this purpose, establishment of a Working Committee is suggested. The Working Committee should be consisted of representatives for each Ministries concerned and staff of the secretarist of the Council as well. The Planning Director of the Council may conduct himself as a organizer of the Working Committee and a staff of the Secretarist as a Secretary of the Committee. Each staff of the Secretarist could cover and deal with each river basin of the country respectively. On the contrary, the Planning Director is a organizer whenever the Working Committee on any river basin project is organized.

A suggested organization is diagrammed in the following:

14. Japan, which had started with similar bureaucratic organization for water resources development as is Tanzania at present, has had difficulties to adjust interests of each Ministries concerned in planning and executing Water Resources Development, until new organization was established in 1961. Once the Water Resources Development Act was enacted in 1961 and the similar organization as I suggest in the above paragraph was established, coordination of planning for all interests concerned has been ensured. Considering the case of Japan, the above proposal is strongly suggested.

## § 5. Acknowledgment.

The team was provided with valuable and useful informations from various organization of Tanzania through elaborated arrangement of Mr. R.A.Collett, Executive Engineer, Ministry of Economic Affairs and Development Planning, who attended the team to take care all the time while staying in Dar es Salaam and Bukoba as well. His collaboration is appreciated very much.

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Dr. W.Peek, Chief Research Officer, Mr. L.M. Rimisho, Regional  
Agricultural Officer in West Lake Region Commission.



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